

BLOOD AND CIRCULATION

Blood

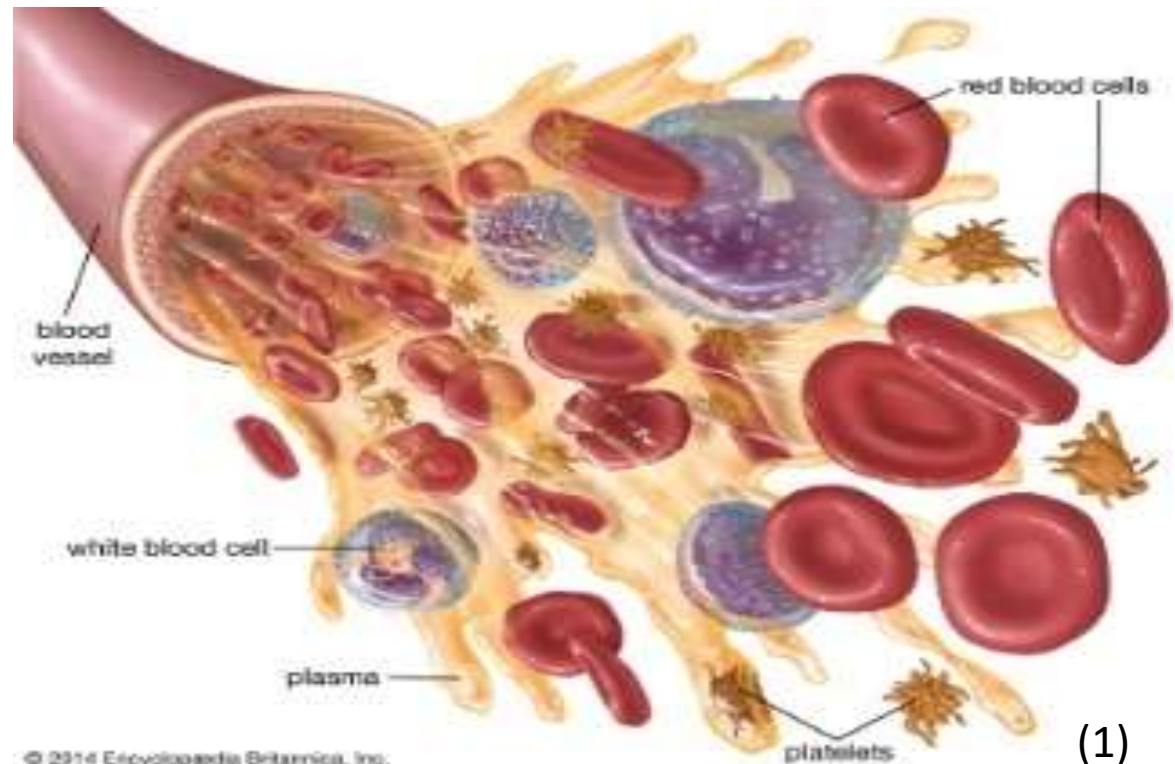
- Blood (connective tissue)
- pH alkaline (7.3-7.4).
- Blood volume:
 - Males: 5-6 L
 - Females: 4-5L

Blood plasma

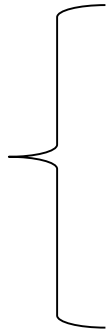
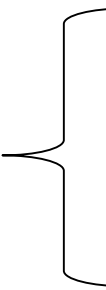
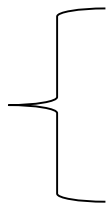
Liquid extracellular matrix

Formed elements

- Cells
- Cell fragments



Functions of blood:

- **Transportation** 
 - Gases (oxygen and carbon dioxide)
 - Nutrients
 - Hormones
 - Heat
 - Wastes
- **Regulation** 
 - pH
 - Body temperature
 - Water content of cells
- **Protection** 
 - Blood loss- clotting
 - Disease – phagocytic activity

Components of blood

Blood plasma	Formed elements
55% volume	45% volume
Straw colored	RBC- red color WBC – no color Platelets no color
Blood- formed elements= blood plasma	Blood- blood plasma= formed elements
Components: 90-92% water 8-10% solutes (approx 7% proteins- albumin, globulin, fibrinogen) Minerals- sodium, calcium, magnesium, bicarbonates, chlorine	3 components: RBC WBC platelets



FORMED ELEMENTS

ERYTHROCYTES	LEUKOCYTES	PLATELETS
Red blood cells (RBC) complete cell	White blood cells (WBC) Complete cell	Thrombocytes Cell fragments
Normal range: Male- 5.4 millions/micro litre of blood Female Female- 4.8 million/ micro litre of blood	Normal range: 5000-10000 cells/ micro litre of blood	Normal range: 150000-400000/ micro litre of blood
Features: No nucleus and membrane bound organelles Biconcave Red colour - hemoglobin	Features: Nucleus present Colorless- No hemoglobin	Features: No nucleus Cytoplasm small enclosed by piece of plasma membrane
Origin: hemopoietic stem cells → erythrocytes	Origin: Hemopoietic stem cells → leukocytes	Origin: Hemopoietic stem cells → megakaryocytes → thrombocytes

Types of Leukocytes (White blood cells)

GRANULOCYTES

Conspicuous chemical filled cytoplasmic granules (vesicles) present and visible after staining

EOSINOPHILS

Features:
Nucleus- bilobed
Cytoplasmic granules- red

Function:
Detoxification

BASOPHILS

Features:
Nucleus- bilobed
Cytoplasmic granules- blue

Function:
Synthesis of Histamine and heparin

NEUTROPHILS

Features:
Nucleus- multilobed ,
(polymorphonuclear leukocytes)
Cytoplasmic granules- pink

Function:
Phagocytic activity

Types of Leukocytes (White blood cells)

AGRANULOCYTES

Conspicuous chemical filled cytoplasmic granules are may be present or absent but invisible after staining

LYMPHOCYTES

Features:
Small cells with round nucleus and little cytoplasm

MONOCYTES

Features:
Cells with single nucleus (Kidney shaped/
horse shoe shaped)
Azurophilic granules present

B-LYMPHOCYTES

Produce antibodies
which binds to
antigen of foreign
particle and causes
destruction

T- LYMPHOCYTES

Directly destroy
cells that have
antigens of
pathogen

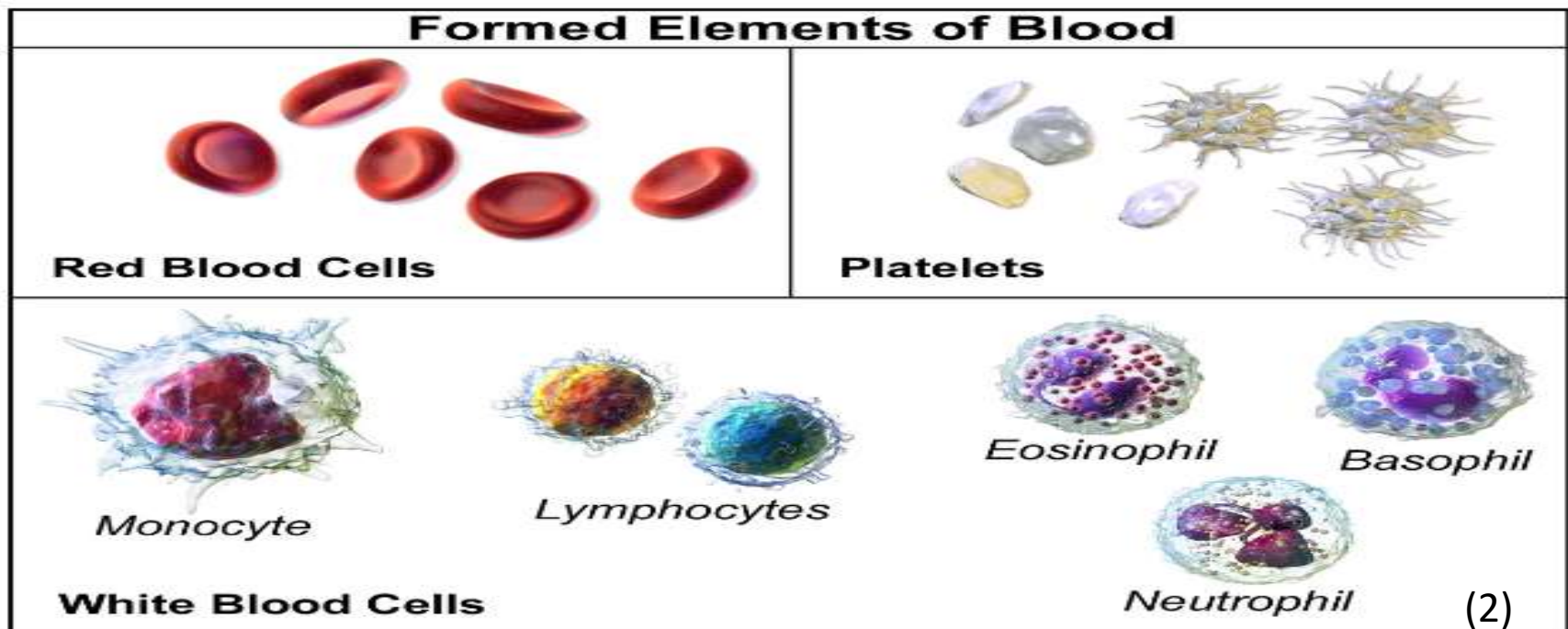
NO SUCH TYPES

Functions:
Immune response

Functions:
Phagocytic activity

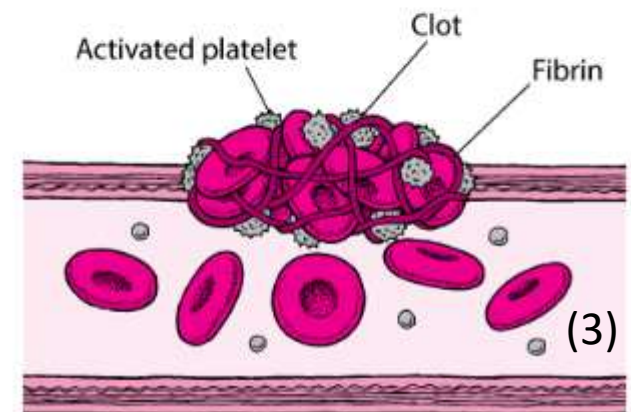
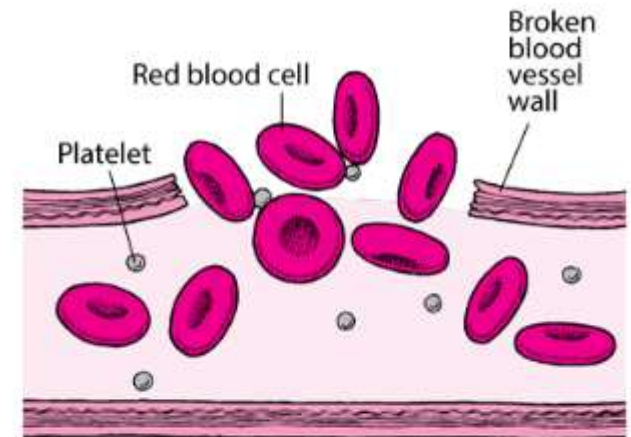
FUNCTIONS OF FORMED ELEMENTS

ERYTHROCYTES	LEUKOCYTES	THROMBOCYTES
Oxygen and carbon dioxide transport	Defense Detoxification Anticoagulant synthesis Phagocytic activity Immune response	Clotting Serotonin synthesis



BLOOD CLOTTING

- Coagulation.
- Transformation of liquid blood into solid gel “clot”
- Clot consists of insoluble proteins “fibrin”; formed elements are trapped.
- Formation of fibrin threads.
- Substance required for clotting are: clotting factors
 - Calcium ions.
 - Inactive enzymes by hepatocytes.
 - Molecules associated with platelets/ released by damaged tissues.
- Main reaction:
 - SOLUBLE FIBRINOGEN $\longrightarrow$ INSOLUBLE FIBRIN



12 Clotting factors

FACTOR	SOURCE	DESCRIPTION
FACTOR I	LIVER	FIBRINOGEN
FACTOR II	LIVER	PROTHROMBIN
FACTOR III	DAMAGED TISSUE, PLATELETS	THROMBOPLASTIN
FACTOR IV	DIET, BONES, PLATELETS	CALCIUM IONS
FACTOR V	LIVER, PLATELETS	PROACCELEREIN
FACTOR VII	LIVER	PROCONVERTIN
FACTOR VIII	LIVER	ANTIHEMOPHILIC FACTOR- A
FACTOR IX	LIVER	ANTIHEMOPHILIC FACTOR- B
FACTOR X	LIVER	THROMBOKINASE
FACTOR XI	LIVER	ANTIHEMOPHILIC FACTOR-C
FACTOR XII	LIVER	ANTIHEMOPHILIC FACTOR-D
FACTOR XIII	LIVER, PLATELETS	FIBRINASE

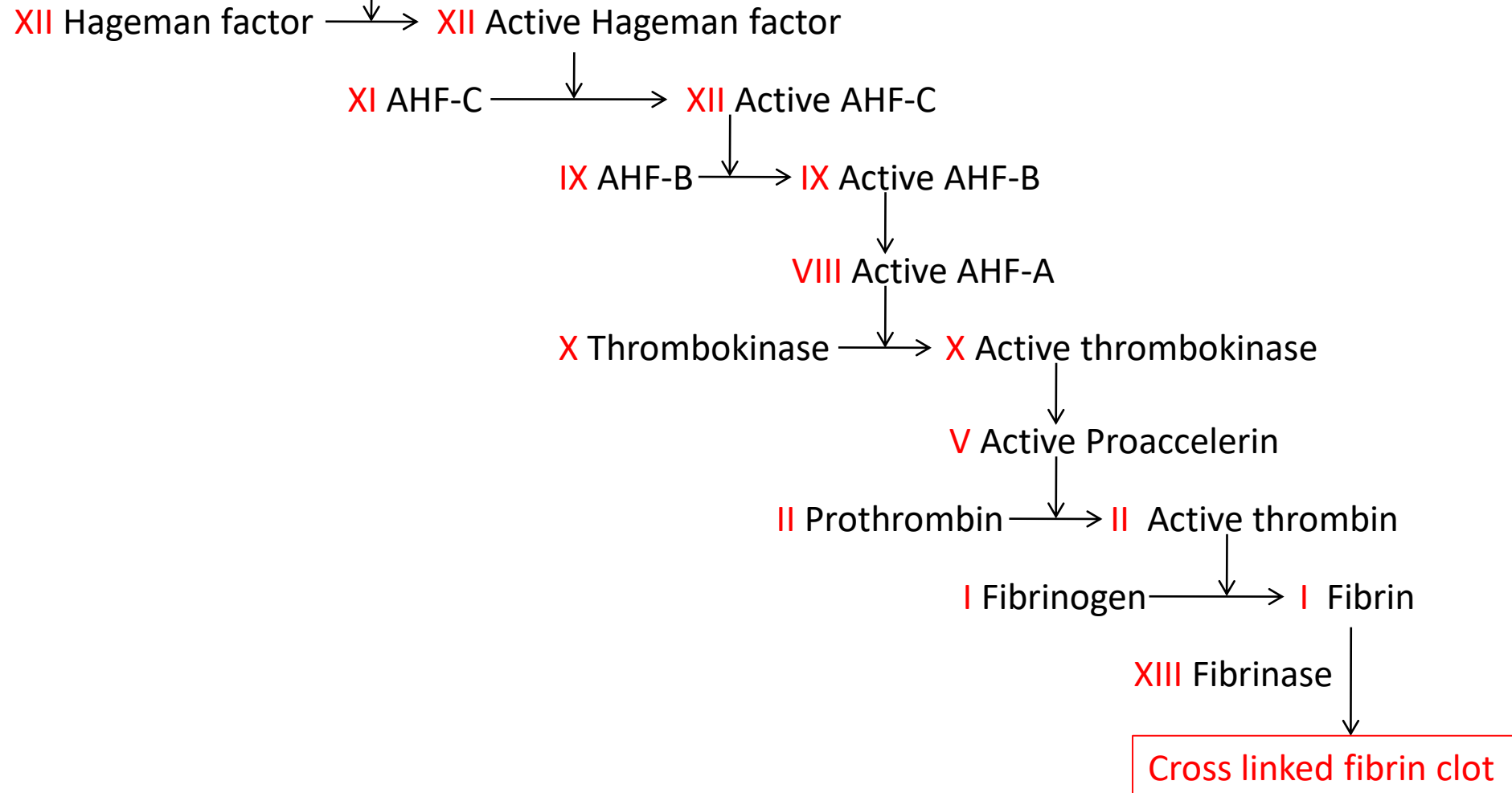
Clotting cascade

EXTRINSIC PATHWAY	INTRINSIC PATHWAY
Shorter pathway	Longer pathway
Rapid process	Slow process
Activator is from cells outside the blood vessels	Activators is in direct contact with blood/ within blood
First reaction: Proconvertin → active Proconvertin	First reaction: Hageman factor → active Hageman factor

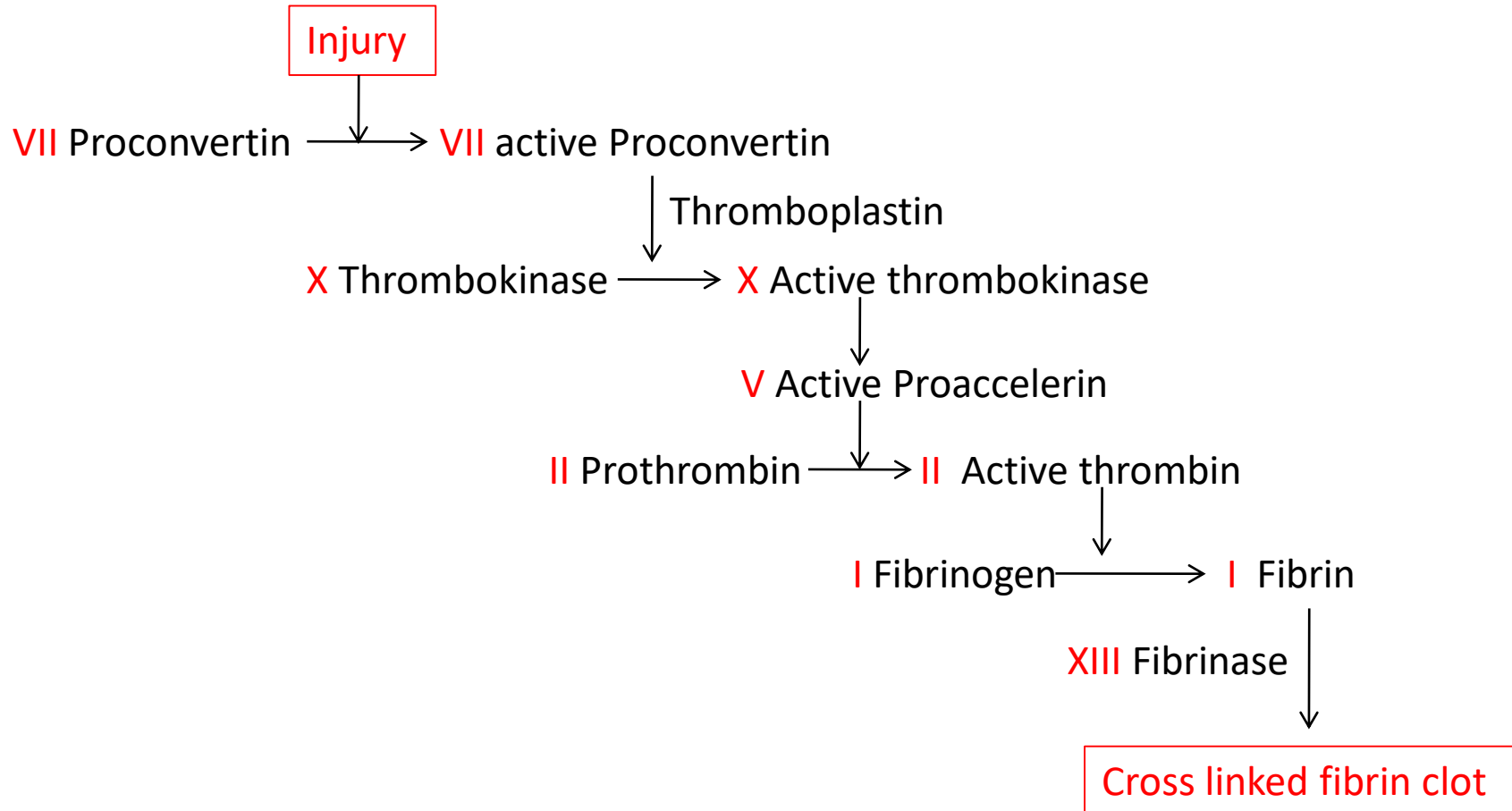
INTRINSIC PATHWAY

Rashmi M G

Damaged surface of blood vessel



EXTRINSIC PATHWAY



Anemia- Reduced Oxygen carrying capacity of blood

Hemolytic anemia

Premature rupture of plasma membrane of RBCs due to invasion of RBC by malarial parasite or sickle cell (defective cells)

Pernicious anemia

Inability to produce intrinsic factor needed for absorption of Vit B12 in small intestine

Hemorrhagic anemia

Excessive loss of RBC through bleeding, stomach ulcers and over menstruation

Megaloblastic anemia

Inadequate intake of Vit B12, red bone marrow produces abnormal RBCs

Iron deficiency anemia

Inadequate absorption of iron or loss of iron in body

Thalassemia

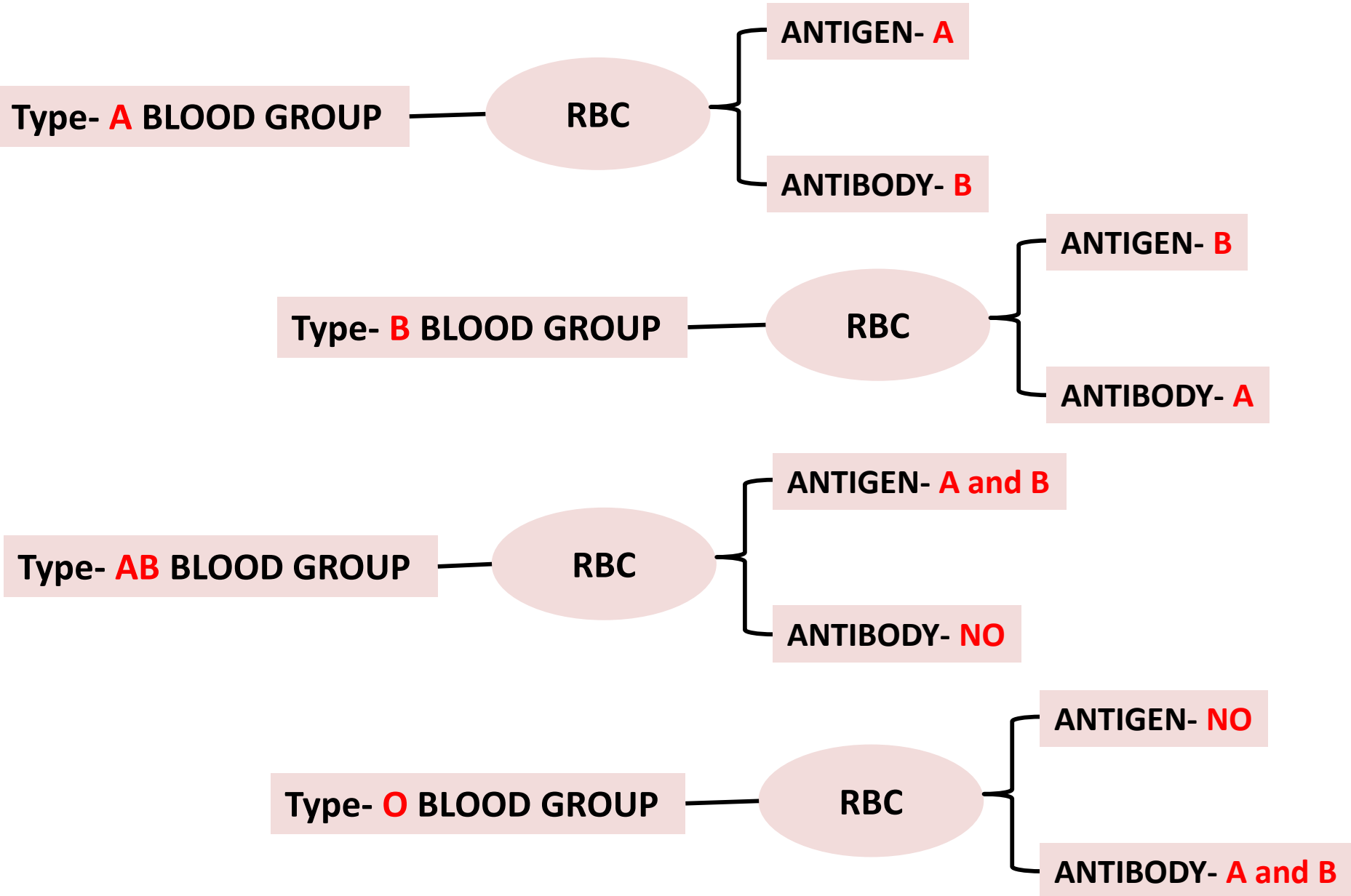
Deficient synthesis of globins, hereditary hemolytic disease

Aplastic anemia

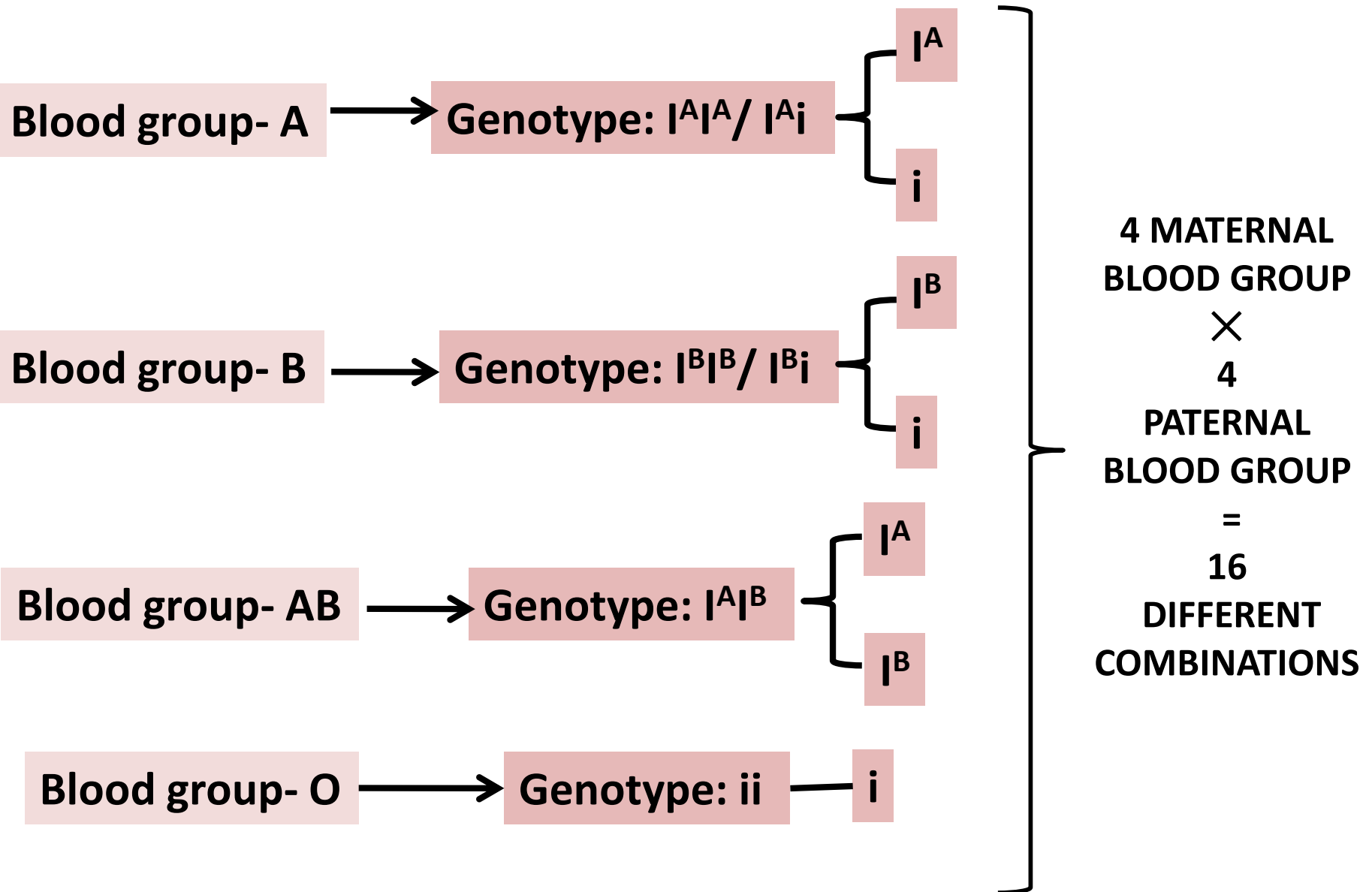
Destruction of red bone marrow, failure of bone marrow to produce RBC

Blood group

Rashmi M G



Predicting blood groups



Parents genes	AA	BB	AB	OO	AO	BO
AA	AA	AB	AA,AB	AO	AA,AO	AB,AO
BB	AB	BB	AB,BB	BO	AB,BO	BB,BO
AB	AA,AB	AB,BB	AA,AB,B B	AO,BO	AA,AB,A O,BO	BB,BO,A B,AO
OO	AO	BO	AO,BO	OO	AO,OO	BO,OO
AO	AA,AO	AB,BO	AA,AB,A O,BO	AO,OO	AA,AO,O O	AO,BO,A B,OO
BO	AO,AB	BB,BO	AB,BO,A O,BB	BO,OO	AB,AO,B O,OO	BB,BO,O O

AA, AO- BLOOD GROUP-A

BB,BO- BLOOD GROUP-B

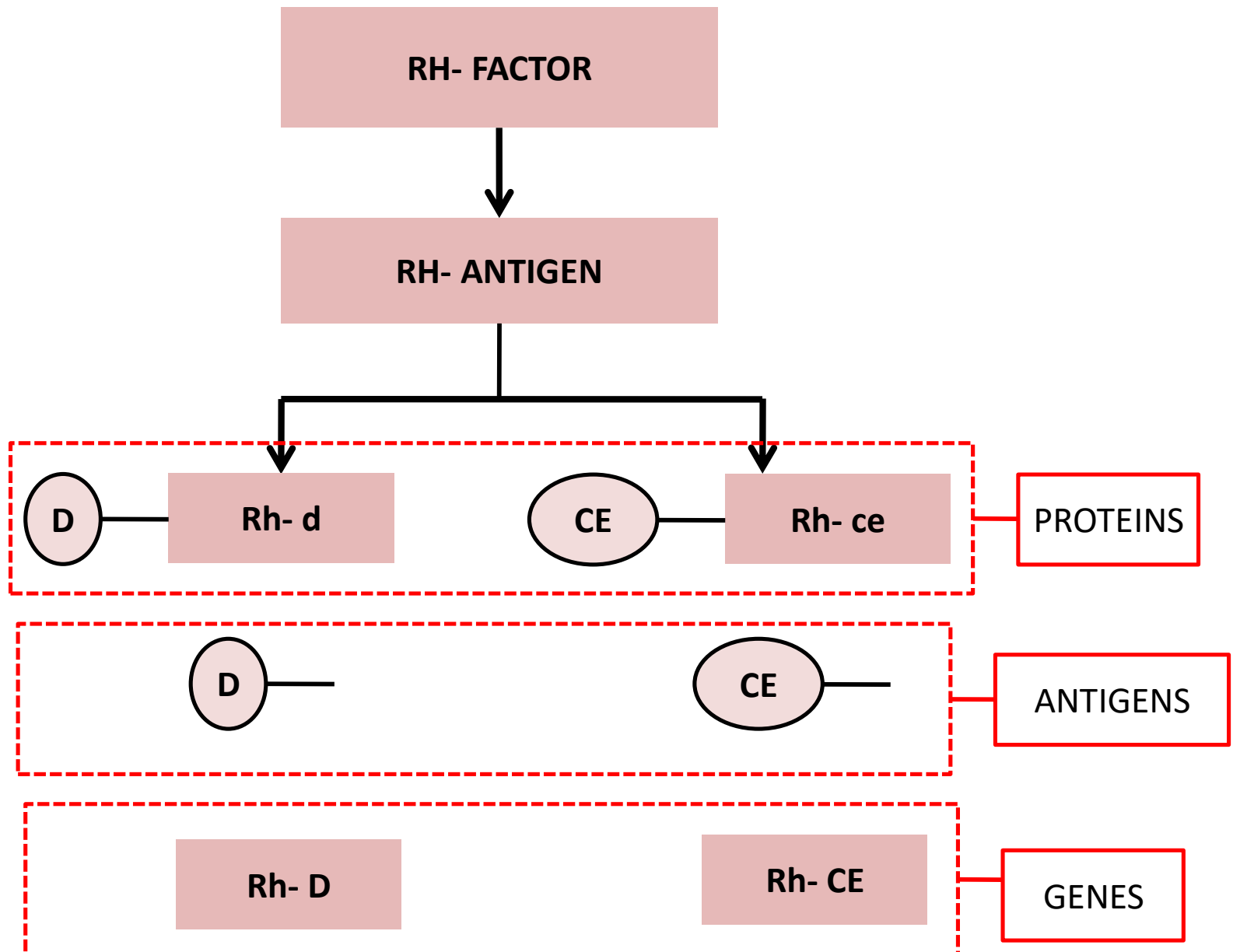
OO- BLOOD GROUP-O

AB- BLOOD GROUP-AB

Rh- blood group

- Rh blood group-1940- Landsteiner and Wiener
- System based on presence/ absence of Rh-antigen/ Rh-factor on plasma membrane of RBC
- Rh factor- Rhesus monkey- *Macacus rhesus*
- *Rh- Negative- RBC lack Rh-D antigen*
- *Rh- Positive- RBC has Rh-D antigen*

Parent	Genotype	Passes genes
Rh-Negative	Rh^{-}/Rh^{-}	Rh^{-} Allele
Rh- Positive	Rh^{+}/Rh^{+} Rh^{+}/Rh^{-}	Rh^{+}/Rh^{-}



Mother

Rh-Negative Blood

Child

Rh-Positive Blood

Fetal and mother blood

Separate -Placenta

There is possibility of Exposure of Maternal Blood to small Amount of Rh-Positive Blood From Fetus during Delivery of 1st Child

During Pregnancy = Usually mother's Rh-Negative blood is not exposed to Rh-Positive blood of Fetus

Mother produces Antibodies Against Rh- Antigen

These antibodies cross Placenta in Subsequent Pregnancy Causes Hemolysis of Rh- Positive RBC of Fetus

Anemia-Erythroblastosis Fetalis

Prevention: Injecting Rh-Negative mother with Antibody prepared against Rh-Antigen (Anti-Rh Antibodies) within 72hours after birth of each Rh- Positive baby
(Passive Immunization)

References

1. <https://www.britannica.com/science/blood-biochemistry>
2. <https://storymd.com/journal/joy3e6lunw-leukocytes-and-platelets/page/zvnopziy7n85-leukocytes-and-platelets>
3. <https://www.msmanuals.com/home/blood-disorders/blood-clotting-process/how-blood-clots>